A Comparitative Study on Hybrid Fiber Reinforced Self-Compacting Concrete by Using Crimped, Hooked Steel Fiber & Fly ash With Different Grades

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Abstract- *The SCC spreads uniformly due to its own weight, without any additional compaction energy, and does not enrain air. SCC in the fresh state of the main features are filling capacity, through the ability and separation resistance. The fibers have been produced in a wide range of materials, shapes and properties. Improve the properties (strength and toughness) of brittle cementitious materials by bridging cracks; pass the crack stress and counteract the crack propagation. Add fibers to the SCC to increase performance, mainly in terms of bending, impact and compressive strength. The fiber can be affected by crowded reinforcement of the flow capacity and the ability to pass, which is considered the main aspect of the SCC. Compared with ordinary self - compacting concrete, the flow strength characteristics of fiber reinforced self compacting concrete and mixed fiber reinforced self compacting concrete are studied. In this study, the M40 & M50 grade self-compacting concrete mix was used by previous researchers. The steel fibers used in this study were crimped steel fibers having a diameter of 0.4 mm x 20 mm (aspect ratio 50) and hooked steel fibers having a diameter of 0.5 mm and a length of 30 mm (aspect ratio of 60). In this study, crimped steel fibers and hook-shaped end steel fibers were added in different proportions to obtain cement with a total fiber content of 2% by weight to obtain various SFRSCC and HFRSCC mixtures. The mixture was designated as SCC0, SFRSCC2C, SFRSCC2H, HFRSCC (0.5C + 1.5H), HFRSCC (1.0C + 1.0H) and HFRSCC (1.5C + 0.5H). This project examines the fresh and hardening properties of SFRSCC and HFRSCC mixtures. With the increase in fiber content in the SCC mix, the flow ability is adversely affected. Mixing fiber-reinforced SCC mixtures have better flow properties than single fiber reinforced SCC mixtures. The addition of fibers to the SCC mixture reduced the flow properties of the SCC mixture but met the acceptance criteria for the SCC mixture. The addition of 0.5C + 1.5H or 1.5C + 0.5H mixed fibers to the SCC mixture provides better flow ability than the combination of 1.0C + 1.0H. The compressive strength of all FRSCC and HFRSCC mixtures was improved compared to the control combination SCC0. The compressive strength of the mixed fiber reinforced SCC mixture was reduced as compared to the single fiber reinforced SCC mixture. The compressive strength of HFRSCC (0.5C + 1.5H) or HFRSCC (1.5C + 0.5H) is greater than that of HFRSCC (1.0C + 1.0H), but in the case of split tensile strength and bending strength.*

I. INTRODUCTION

Self-compacting concrete was originally developed in Japan and Europe. Even in the case of reinforcement, can simply flow through the weight and fill the corners of the concrete, without any vibration or other types of compaction.
Compared with conventional concrete, due to better compaction, non-SCC and other tensile strength, the elastic modulus may be slightly higher due to the paste and slightly increase the paste, the shrinkage of concrete normal, bond strength Better, fire resistance and non-SCC similar to the durability is better than surface concrete.

However, various studies have been carried out to explore the various features and structural applications of SCC. The SCC has established effective materials and therefore needs to guide the normalization of its own integration features and its application in different construction applications and to use all hazardous and inaccessible project areas to achieve superior quality control.

Self-compacting concrete (SCC) is an innovative concrete that does not require placement and compaction of vibrations, it can flow freely, fully fill the template and achieve full compaction, even with crowded steel bars.

1.1 Literature review:

Nan Sua, Kung-Chung Hsu et al. In 2001, a new type of concrete self-compacting concrete design method (SCC)was proposed. The results show that this method can successfully produce high quality SCC. Compared with the method developed by the Japan Ready-Mixed Concrete Association (JRMCA), this method is simpler, easier to implement, more time-saving, reduced bundling and cost savings.

Behnam Vakhshouri, Shami Nejadi 2016 shows a hybrid design of light self-compacting concrete. The advantages of combining LWC and SCC are a new field of research. Taking into account the light weight and ease of placement of the structure, light self-compacting concrete may be the answer to the growing construction requirements for extending and strengthening structural components.

Kishor S Sable, Madhuri Ketal. The effects of different types of steel fibers and aspect ratio on the mechanical properties of self - compacting concrete are proposed. The purpose of this study was to determine and compare the properties of fiber concrete without fiber and concrete, as well as the effects of fiber and self-compacting concrete on different types and aspect ratios. A number of tests were conducted, including SCC's workability test, compression test, direct tensile test and bending test.

N.Nalanth et al. In 2014, recycled materials were used as an alternative to assess the freshness and hardening properties of steel fiber reinforced self-compacting concrete. In this study, the addition of steel fibers to the concrete improves the mechanical properties of the SCC and can be applied to beams and column joints. Determine the compression, tensile and bending strength parameters and give the results. The results show that the combination of brick and steel fiber can be widely used in SCC.

Haddadou N, Chaid R et al. 2014 proposed the effect of mixed steel fibers on the properties of fresh and hardened self-compacting concrete. The purpose of this study was to compare the performance of SCC and fiber reinforced self-compacting concrete (FRSCC) with a large number of mineral additives. Two different types of steel fibers are combined using different lengths of 50 mm and 30 mm. The results show that mechanical properties are improved by introducing steel fibers, in particular splitting tensile strength and flexural strength in to SCC.

SyalTarun, Goel Sanjay et al. The workability and compressive strength of polypropylene reinforced fiber reinforced self - compacting concrete were proposed. In this paper, two different types of fibers of steel fiber (SF) and polypropylene fiber (PPF) are used in different combinations of 25-75%, 50-50%, 75-25% and total fiber volume fraction of 0.5% use. The effects of fiber inclusions on the processing performance and compressive strength parameters of hybrid fiber reinforced self - compacting concrete (HFRSCC) were studied.

1.2 Objectives of the study:

The work reported in this study, the usage of fiber with different percentages in the concrete corresponding results by partial addition of fibers and compared with controlled concrete and plotting the corresponding graphs separately.

The present investigation is aimed to study the compressive Strength, split tensile strength and flexural strength of M40 & M50 grade of concrete mix with a partial addition of fiber with hooked & crippled fibers. The fibers are added to the concrete with different percentages as 0%, 0.5C + 1.5H, 1.0C + 1.0H, 1.5C + 0.5H with normal concrete. The Compressive Strength was calculated at the age of 7, 28days. The splitting tensile strength and flexural strength tests were calculated at the age of28days.

1.3 Experimental Investigation:

1.3.1 Materials used

Cement: Ordinary Port l and cement of 53 grade was used. The Cement used has been tested for various proportions as per IS IS 4031-1988 and found to be confirming to various specifications of12269-1987.

Fine aggregate

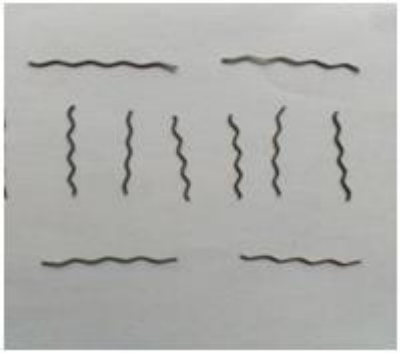
The material which passes through BIS test sieve number 4 (4.75mm) is termed as fine aggregate usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone is used as fine aggregates. In our region fine aggregate can be found from bed of Krishna River. It conforms to IS: 383 1970 comes under zone II.

Coarse aggregate

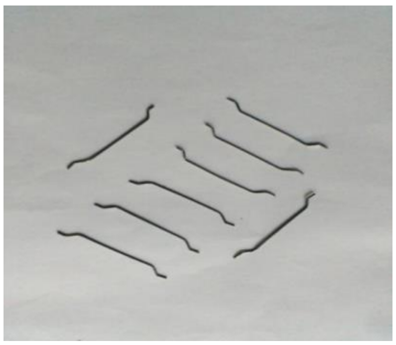
Coarse aggregate crushed angular granite metal of 12 mm, 20mm size was used.

20 mm size Steel fibers:

In this study, crimped steel fibers and steel hook ends were used, as shown in fig. Steel fiber is made of cold drawn steel. Galvanized, stainless steel.



Crimped steel fibers



Hooked end steel fibers

Tables 1 shows the physical properties of fibers.

Table1: physical properties

S.N o	Property	Steel hooked end	Steel crimpled
1	Diameter	0.50 mm	0.4 mm
2	Length	30 mm	20 mm
3	Aspect ratio L/D	60	50
4	Yield strength of wire	>1000 M pa	>1000 M pa
5	Wire tensile strength	>1450 M pa	1100 M pa
6	Strain at failure	< 4%	
7	Tolerance for D/L	+/- 10%	+/- 10%
8	Appearance	Bright and clean wire	Bright and clean Wire

II. EXPERIMENTAL PROGRAM

2.1 Mix Proportions:

Mix proportions were adopted as per South sue self compacting concrete &IS-10262-2009.Fortest specimens 53 grade port land cement, natural river sand and coarse aggregate, fly ash is being utilized. The experimental program was designed to the study of mechanical properties of concrete with additional of fibers to the concrete for M40 & M50 grade of concrete.

Compressive Strength of Cubes

The compressive strength of concrete was determined by conducting tests on 150 mm x 150 mm x 150 mm cube specimens were casted and cured for 7 and 28 days. The test was carried out in the compression testing machine of 2000kNcapacity.Inthistest36cubesweretested.Thecubes were placed in the compression testing machine and the load was applied until the failure of the specimen. The average values of three samples were taken as strength.

The compressive strength of the cubes after addition of fibers with SCC0, SFRSCC2C, SFRSCC2H, HFRSCC (0.5C + 1.5H), HFRSCC (1.0C+1.0H) and HFRSCC (1.5C+0.5H) is studied for 7 & 28days shown in Table 2 & 3.

Table 2: Compressive Strength of M40 Mix concrete

S.No	Percentage of fibres added	7 Days(Mpa)	28 Days(Mpa)
1	0C+0H	31.10	46.05
2	0.5C+1.5H	38.15	49.40
3	1.0C+1.0H	32.00	45.10
4	1.5C+0.5H	34.25	46.55

Table 3: Compressive Strength of M50 Mix concrete

S.No	Percentage of fibres added	7 Days(Mpa)	28 Days(Mpa)
1	0C+0H	37.68	54.93
2	0.5C+1.5H	43.06	58.68
3	1.0C+1.0H	38.14	53.46
4	1.5C+0.5H	40.67	55.78

Split Tensile Strength of Cylinders

The determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. Split tensile strength is an indirect method of finding out the tensile strength of concrete. Tensile splitting strength of 150 mm diameter and 300 mm height cylinders tested and 18 cylinders were prepared. The test is carried out by placing the cylindrical specimens horizontally between the loading surfaces of the compression testing machine and the load is applied until the failure of the cylinder.

The split tensile strength of the cylinders after addition of fibers with SCC0, SFRSCC2C, SFRSCC2H, HFRSCC (0.5C +1.5H), HFRSCC (1.0C+1.0H) and HFRSCC (1.5C+0.5H) is studied for 7 & 28days shown in Table 4 & 5.

Table 4: Split tensile Strength of M40 Mix concrete

S.No	Percentage of fibres added	28 Days
1	0C+0H	3.02
2	0.5C+1.5H	3.45
3	1.0C+1.0H	3.73
4	1.5C+0.5H	3.32

Table 5: Split tensile Strength of M50 Mix concrete

S.No	Percentage of fibres added	28 Days
1	0C+0H	3.86
2	0.5C+1.5H	4.12
3	1.0C+1.0H	4.49
4	1.5C+0.5H	3.91

Flexural Strength of Prism

Flexural strength tests were carried out on 150 mm x150mm x 700 mm beams on the 28th day using Universal Testing Machine (UTM) apparatus. The system of loading used in finding out the flexural tension is two point loading as perIS 516–1959.

The flexural strength of the beams after addition of fibers with SCC0, SFRSCC2C, SFRSCC2H, HFRSCC (0.5C + 1.5H), HFRSCC (1.0C + 1.0H) and HFRSCC (1.5C + 0.5H) is studied for 7 & 28days shown in Table 6 & 7.

Table 6: Flexural Strength of M40 Mix concrete

S.No	Percentage of fibres added	28 Days(Mpa)
1	0C+0H	5.931
2	0.5C+1.5H	5.983
3	1.0C+1.0H	6.056
4	1.5C+0.5H	5.766

Table 7: Flexural Strength of M40 Mix concrete

S.No	Percentage of fibres added	28 Days
1	0C+0H	6.083
2	0.5C+1.5H	6.511
3	1.0C+1.0H	6.826
4	1.5C+0.5H	5.973

III. DISCUSSIONS AND RESULTS

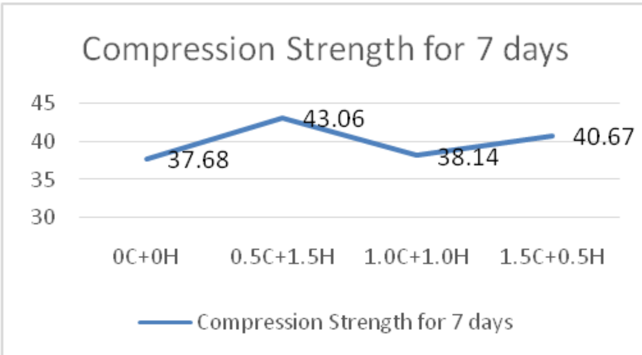
As can be seen from the results, as the grade of concrete increases, the effective maximum size of the aggregate decreases. In the above case, M40 grade cement content of 480 kg/m^3, M50 grade cement content of 465 kg/m^3.Four different percentages of the above two fibers have been achieved and the same method is used for further study.

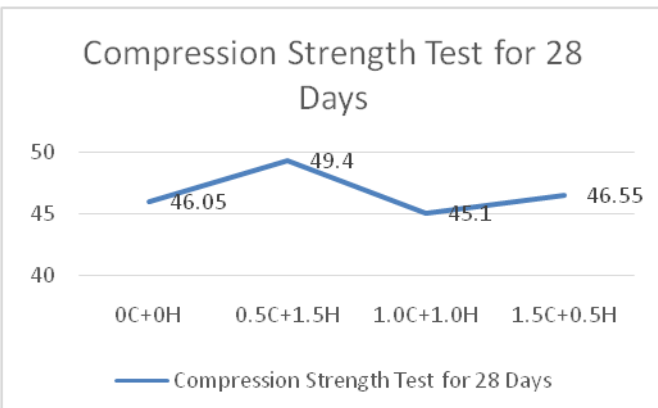
The split tensile strength of the M40 & M50 grades of concrete with different percentages. With regard to the percentage of fibers, note a trend similar to compressive strength. All of these two different healing ages are true.

The details of the flexural strength of different percentages of fibers and two grades of concrete. At 7 and 28 days, the effective size of the aggregate of the M40 & M50 grade concrete is 12mm.

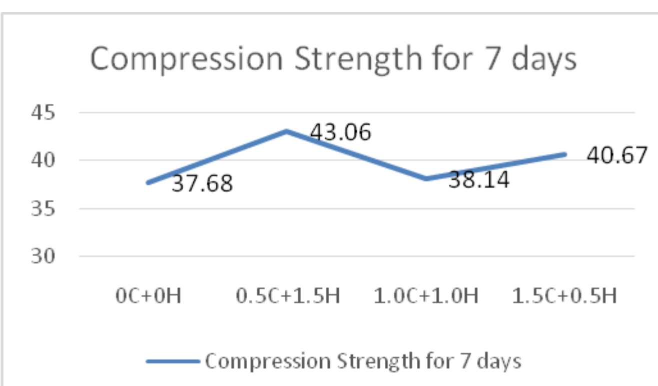
Graphs:

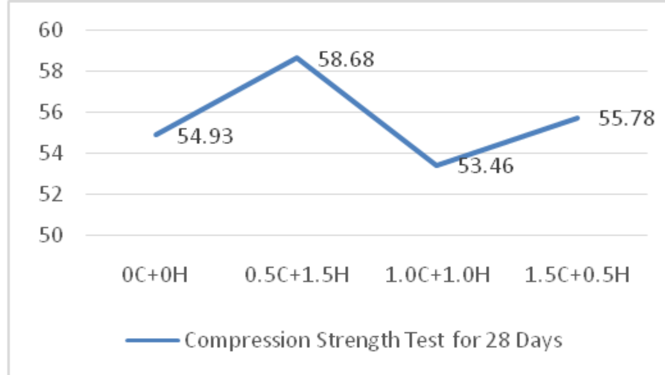
Graph1 Compressive strength of M40 Grade mix with various % of fibers at the age of 7 & 28 days.



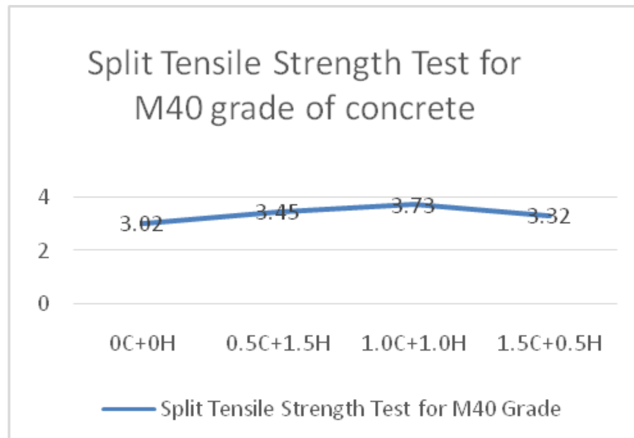


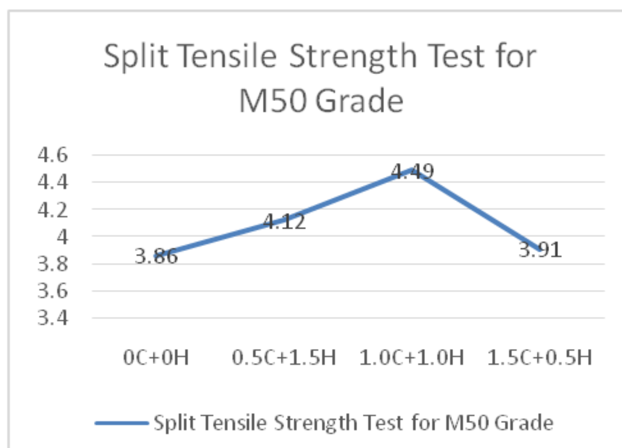
Graph 2 Compressive strength of M50 Grade mix with various % of fibers at the age of 7 & 28 days.





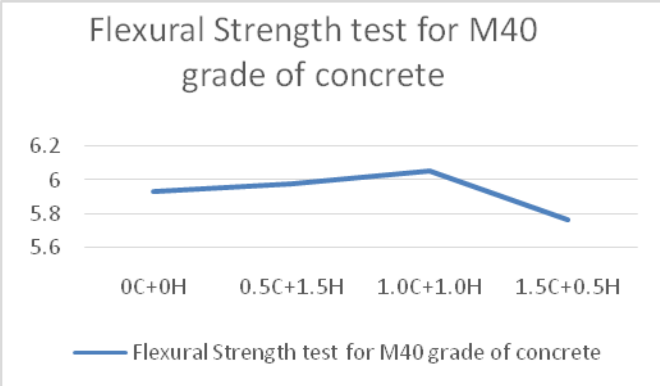
Graph 3 Split tensile strength of M40 & M50 Grade mix with various % of fibers at the age of 28days.

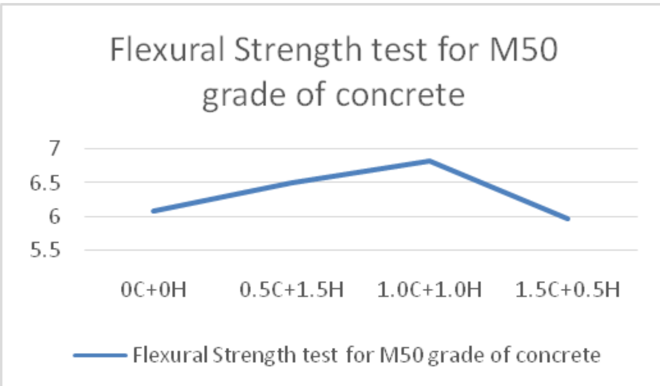




Graph4

Flexural strength of M40 & M50 Grade mix with various % of fibers at the age of 28 day





IV. CONCLUSIONS

Based on a detailed experimental study of the SCC portfolio, the purpose is to develop a combination of performance and draw the following conclusions.

- A mixture of 0.5% C + 1.5% H and 1.5% C + 0.5% H produced better freshness than 1.0% C + 1.0%H.
- In the compression strength test values it has been observed that 0.5% C + 1.5% H and 1.5% C + 0.5%H shows better results when compared to 1.0% C + 1.0% H.
- In the split tensile strength test values it has been observed that 1.0% C + 1.0% H shows better results when compared to 0.5% C + 1.5% H and 1.5% C + 0.5% H
- In the flexural strength test values it has been observed that 1.0% C + 1.0% H shows better results when compared to 0.5% C + 1.5% H and 1.5% C + 0.5% H
- The developed SCC mix with and without the addition of hybrid fibres (Crimped and Hooked) satisfy the rheological properties.
- From the fresh property results it can be concluded that adding fibres affects the workability of fresh concrete

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